National Aeronautics and
Space Administration

Langley Research Center
Hampton, VA 23681-2199

Educational Product	
Educators	Grades 3-5

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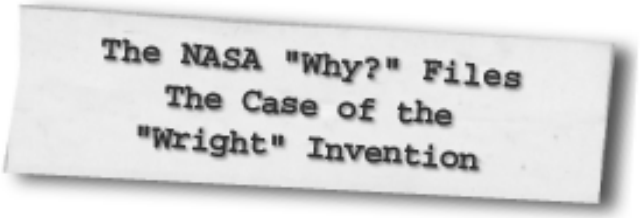
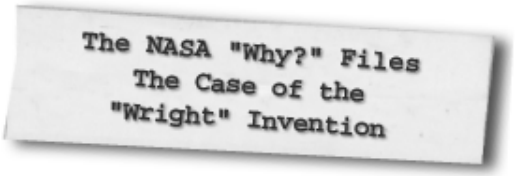


A Lesson Guide with Activities in Mathematics, Science, and Technology

The Case of the "Wright" Invention lesson guide is available in electronic format through NASA Spacelink - one of NASA's electronic resources specifically developed for the educational community. This publication and other educational products may be accessed at the following address: **http://spacelink.nasa.gov/products**

A PDF version of the lesson guide for NASA "Why?" Files can be found at the NASA "Why?" Files web site: **http://whyfiles.larc.nasa.gov**



A Lesson Guide with Activities in Mathematics, Science, and Technology

For additional information about the NASA "Why?" Files, contact Shannon Ricles at (757) 864-5044 or e-mail **s.s.ricles@larc.nasa.gov**.

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Program Overview

When the tree house detectives hear a report on KSNN about a young inventor's contest, they decide it might be their next case. Thus begins *The Case of the "Wright" Invention*.

The tree house detectives are not even quite sure what an invention is, much less how to create one. Seeking some advice, they visit Dr. D, a retired science professor, who helps the tree house detectives understand that the process of invention is similar to the scientific method. Armed with new confidence, they set out to create a "bug" list of ideas to find a problem to solve!

As the tree house detectives learn about inventors, they get a little help from mysterious sources, Orville and Wilbur Wright. The tree house detectives are not sure whether these brothers are real or just actors. The tree house detectives also visit a young inventor, Lindsey Clements, who shows them that even kids can be inventors. NASA researchers and other community experts also help the tree house detectives learn how to plan, design, build, and test their invention. They discover that inventing is not as easy as they thought, even for Orville and Wilbur Wright!

National Geography Standards (grades 3–5)

	Segment			
Standard	**1**	**2**	**3**	**4**
The geographically informed person knows and understands				
The World in Spatial Terms				
How to use maps and other graphic representations, tools, and technologies to acquire, process, and report information from a spatial perspective	x	x	x	x
Environment and Society				
How physical systems affect human systems	x	x	x	x
Uses of Geography				
How to apply geography to interpret the past			x	x

National Science Standards (Grades K – 4)

Standard	Segment 1	2	3	4
Unifying Concepts and Processes				
Systems, orders, and organization	X	X	X	X
Evidence, models, and explanations	X	X	X	X
Change, constancy, and measurement	X	X	X	X
Science and Inquiry (Content Standard A)				
Abilities necessary to do scientific inquiry	X	X	X	X
Understandings about scientific inquiry	X	X	X	X
Physical Science (Content Standard B)				
Properties of objects and materials			X	
Science and Technology (Content Standard E)				
Abilities of technological design	X	X	X	X
Understanding about science and technology	X	X	X	X
Abilities to distinguish between natural objects and objects made by humans	X	X	X	X
Science in Personal and Social Perspective (Content Standard F)				
Personal health	X	X	X	X
Science and technology in local challenges	X	X	X	X
History and Nature of Science (Content Standard G)				
Science as a human endeavor	X	X	X	X

National Science Standards (Grades 5 – 8)

Standard	Segment 1	2	3	4
Unifying Concepts and Processes				
Systems, order, and organization	X	X	X	X
Evidence, models, and explanations	X	X	X	X
Change, constancy, and measurement	X	X	X	X
Science as Inquiry (Content Standard A)				
Abilities necessary to do scientific inquiry	X	X	X	X
Understanding about scientific inquiry	X	X	X	X
Physical Science (Content Standard B)				
Properties and changes of properties in matter			X	
Science and Technology (Content Standard E)				
Abilities of technological design	X	X	X	X
Understanding about science and technology	X	X	X	X
Science in Personal and Social Perspectives (Content Standard F)				
Personal health	X	X	X	X
Science and technology in society	X	X	X	X
History and Nature of Science (Content Standard G)				
Science as a human endeavor	X	X	X	X
Nature of science	X	X	X	X
History of science	X	X	X	X

National Mathematics Standards (Grades 3 – 5)

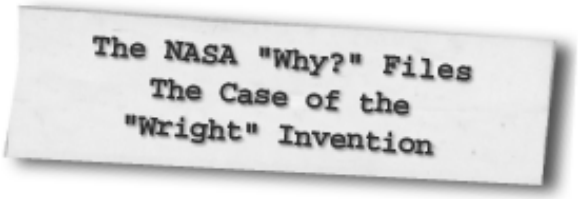
Standard	Segment 1	2	3	4
Number and Operations				
Understand meanings of operations and how they relate to one another.			X	
Compute fluently and make reasonable estimates.			X	
Algebra				
Understand patterns, relations, and functions.			X	
Use mathematical models to represent and understand quantitative relationships.			X	
Analyze change in various contexts.			X	
Measurement				
Understand measurable attributes of objects and the units, systems, and processes of measurement.			X	
Apply appropriate techniques, tools, and formulas to determine measurements.			X	
Data Analysis and Probability				
Formulate questions that can be addressed with data and collect, organize, and display relevant data to answer them.			X	
Select and use appropriate statistical methods to analyze data.			X	
Develop and evaluate inferences and predictions that are based on data.			X	
Problem Solving				
Build new mathematical knowledge through problem solving.			X	
Solve problems that arise in mathematics and in other contexts.	X	X	X	X
Apply and adapt a variety of appropriate strategies to solve problems.			X	
Monitor and reflect on the process of mathematical problem solving.			X	
Communication				
Organize and consolidate their mathematical thinking through communication.			X	
Communicate their mathematical thinking coherently and clearly to peers, teachers, and others.			X	
Analyze and evaluate the mathematical thinking and strategies of others.			X	
Representation				
Create and use representations to organize, record, and communicate mathematical ideas.			X	
Select, apply, and translate among mathematical representations to solve problems.			X	
Use representations to model and interpret physical, social, and mathematical phenomena			X	

National Technology Standards (ITEA Standards for Technology Literacy, Grades 3 – 5)

Standard	Segment 1	2	3	4
Nature of Technology				
Standard 1: Students will develop an understanding of the characteristics and scope of technology.	X	X	X	X
Standard 2: Students will develop an understanding of the core concepts of technology.	X	X	X	X
Standard 3: Students will develop an understanding of the relationships among technologies and the connections between technology and other fields of study.	X	X	X	X
Technology and Society				
Standard 6: Students will develop an understanding of the role of society in the development and use of technology.	X	X	X	X
Standard 7: Students will develop an understanding of the influence of technology on history.	X	X	X	X
Design				
Standard 8: Students will develop an understanding of the attributes of design.	X	X	X	X
Standard 9: Students will develop an understanding of engineering design.	X	X	X	X
Standard 10: Students will develop an understanding of the role of troubleshooting, research and development, invention and innovation, and experimentation in problem solving.	X	X	X	X
Abilities for a Technological World				
Standard 11: Students will develop the abilities to apply the design process.	X	X	X	X
Standard 12: Students will develop abilities to use and maintain technological products and systems.	X	X	X	X
Standard 13: Students will develop abilities to assess the impact of products and systems.	X	X	X	X
The Designed World				
Standard 17: Students will develop an understanding of and be able to select and use information and communication technologies.	X	X	X	X
Standard 18: Students will develop an understanding of and be able to select and use transportation technology.	X	X	X	X
Standard 20: Students will develop an understanding of and be able to select and use construction technologies.			X	X

National Technology Standards (ISTE National Educational Technology Standards, Grades 3 – 5)

Standard	Segment 1	2	3	4
Basic Operations and Concepts				
Use Keyboards and other common input and output devices efficiently and effectively.	X	X	X	X
Discuss common uses of technology in daily life and the advantages and disadvantages those uses provide.	X	X	X	X
Technology Productivity Tools				
Use general purpose productivity tools and peripherals to support personal productivity, remediate skill deficits, and facilitate learning throughout the curriculum.	X	X	X	X
Use technology tools for individual and collaborative writing, communication, and publishing activities to create knowledge products for audiences inside and outside the classroom.	X	X	X	X
Technology Communication Tools				
Use technology tools for individual and collaborative writing, communication, and publishing activities to create knowledge products for audiences inside and outside the classroom.	X	X	X	X
Use telecommunication efficiently and effectively to access remote information, communicate with others in support of direct and independent learning, and pursue personal interests.	X	X	X	X
Use telecommunication and online resources to participate in collaborative problem-solving activities for the purpose of developing solutions or products for audiences inside and outside the classroom.	X	X	X	X
Technology Research Tools				
Use telecommunication and online resources to participate in collaborative problem-solving activities for the purpose of developing solutions or products for audiences inside and outside the classroom.	X	X	X	X
Use technology resources for problem solving, self-directed learning, and extended learning activities.	X	X	X	X
Determine when technology is useful and select the appropriate tools and technology resources to address a variety of tasks and problems.	X	X	X	X
Technology Problem-Solving and Decision-Making Tools				
Use technology resources for problem solving, self-directed learning, and extended learning activities.	X			



Segment 1

During the lazy days of summer, the tree house detectives are a little "bored." When they hear a KSNN announcement about an invention contest, their interest suddenly peaks. Although they are not quite sure what an inventor does, they remember learning that Orville and Wilbur Wright were famous inventors and decide to research their inventions.

As the tree house detectives begin to read about the Wright brothers, the pages come to life and they discover the brothers earnestly discussing ways to solve the problem of controlling their glider. Wilbur thinks he has finally defined the problem and that they are ready to find a solution. The tree house detectives are now even more curious about this invention stuff and decide to visit Dr. D, who just might help answer their questions.

Dr. D guides the tree house detectives to discover that the invention process is very similar to the scientific method. He explains that to become inventors, they need to think of problems that must be solved. The tree house detectives decide that there is a real need to make bike riding safer. To do that, they need to make bicycles more visible at night. Now that they have defined their problem, they are unsure of their next step.

The tree house detectives solicit the help of a young inventor named Lindsey Clements. Lindsey tells the tree house detectives how she invented a "gumball" machine. Motivated by her success, the tree house detectives decide to "bug" out to learn more about inventors. But wait, they see the Wright brothers again!

Objectives

The student will

- learn the steps of the invention process.
- identify a simple problem.
- understand that scientists use different kinds of investigations, depending on the questions they are trying to answer.
- understand that people have always had problems and have invented tools and techniques to solve them.
- understand that people of all ages engage in a variety of scientific and technological work.

Vocabulary

invention - an original device, idea, or process originated after study and experiment—a discovery or a new finding

invention process - the act or power of inventing; a step-by-step way of inventing

inventor - someone who creates or produces an original device, idea, or process

log - a written record of daily activities kept by an inventor while working on an invention

scientific method - the rules and methods for the pursuit of knowledge that involve finding and stating a problem, the collection of facts through observation and experiment, and the making and testing of ideas that need to be proven right or wrong

wing warping - twisting of the wing by using control cables to induce a gently banked turn that improves the control system, allowing for lateral movement. This original process, invented by the Wright brothers, led to successful flight.

Wright brothers - Orville and Wilbur Wright are credited with being the first to successfully complete a controlled, powered flight of a heavier-than-air airplane with a pilot onboard

Video Component

Implementation Strategy

The NASA "Why?" Files is designed to enhance and enrich the existing curriculum. Two to three days of class time is suggested for each segment to fully use video, resources, activities, and web site.

Before Viewing

1. Prior to viewing Segment 1 of *The Case of the "Wright" Invention*, read the program overview (p. 11) to the students. List and discuss questions and preconceptions that students may have about inventors and inventions.
2. Record a list of issues and questions that the students want answered in the program. The following tools are available on the web site to assist students in the invention process:

   Problem Board - printable form to create student or class K-W-L Chart

   PBL Questions - questions for students to use while conducting research

   Design Log - printable log for students to record their invention process

   Scientific Process Log - chart that describes the scientific process

3. Focus Questions - questions at the beginning of each segment help students focus on a reason for viewing the broadcast (video). Questions can be printed from the web site to allow students to copy them into their science journals. Remind students to look for the Focus Question icon as the answer to the focus question appears.
4. To create an invention booklet, use pages in each segment marked with an asterisk (*).

2001 – 2002 NASA "Why?" Files Programs

View Segment 1 of the Video

For optimal educational benefit, view *The Case of the' "Wright" Invention* in 15-minute segments and not in its entirety. If you are viewing a taped copy of the program, you may want to stop the video when the Focus Question icon appears to allow students time to answer the question.

After Viewing

1. Have students discuss the focus questions for segment 1 and record answers.
2. Have students discuss and reflect in their science journals the "What's Up?" questions asked at the end of each segment.
3. Have students work in groups or as a class to discuss the problem that the tree house detectives chose (making bikes more visible at night). Have students develop a list of pros and cons for the problem and guide students in a discussion to determine a class consensus on the validity of the problem. Extend the discussion to include other possible problems the tree house detectives could have chosen.

Careers

inventor
pilot
cyclist
bicycle repair person

4. Choose activities from the educator's guide and web site to reinforce concepts presented in the segment. The variety of activities is designed to enrich and enhance your curriculum. A class invention contest complements the program and reinforces the invention process. Activities are included to support such a contest.
5. Have students work individually, in pairs, or in small groups on the Problem-Based Learning (PBL) activity on the NASA "Why?" Files web site.

   To begin the PBL activity, read the scenario to the students.

   Read and discuss the various roles involved in the investigation. Have each student choose his/her role.

   Print the criteria for the investigation and distribute.

   Have students use the Research Rack located on the web site and the online tools that are available.
6. Having students reflect in their journals what they have learned from this segment and from their own experimentation and research is one way to assess their understanding. In the beginning, students may have difficulty reflecting. To help students, give them specific questions related to the concepts to reflect upon.
7. The NASA "Why?" Files web site provides checklists and rubrics that may assist teachers in assessing students' understanding of the material presented.

Resources (additional resources located on web site)

Books

Flatow, Ira: *They All Laughed: From Light Bulbs to Lasers: The Fascinating Stories Behind the Great Inventions That Have Changed Our Lives.* Harperperennial Library, 1993, ISBN: 0060924152

Freedman, Russell; Wilbur Wright; Orville Wright: *The Wright Brothers: How They Invented the Airplane*. Holiday House, 1994, ISBN: 082341082X

Jones, Charlotte Foltz: *Mistakes That Worked*. Doubleday, 1994, ISBN: 0385320434

LaFontaine, Bruce: *The Story of the Wright Brothers*. Dover Publications, Inc., 2000, ISBN: 0486413217

McCormack, Alan J.: *Inventors Workshop.* Fearon Teacher Aids, 1981, ISBN: 0822497832

Wulffson, Don L.: *The Kid Who Invented the Trampoline: More Surprising Stories About Inventions.* Dutton Books, 2001, ISBN: 0525466541

Web Sites

NASA "Why?" Files
Come explore the NASA "Why?" Files web site and learn how six tree house detectives use Problem-Based Learning and scientific inquiry to solve mysteries in their community. After conducting research and experimenting in Dr. D's Lab, learn to be a detective yourself!
http://whyfiles.larc.nasa.gov

Wright Flyer Online Kids' Corner
Part of NASA's "Aero Design Team" web site has information on the Wright brothers and Wright airplanes. It includes contests for young people, special events, games, and even a comic book version of the Wright story.
http://quest.arc.nasa.gov/aero/wright/kids/index.html

Wright Brothers' Aeroplane Company & Museum of Pioneer Aviation
This comprehensive site with everything "Wright" includes pioneer aviation history, hands-on aviation adventures, virtual expeditions, and timely information. It even has a virtual hangar with six operational Wright aircraft. A "must see" for Wright brothers enthusiasts of all ages.
http://www.first-to-fly.com/

National Gallery for America's Young Inventors
The National Gallery for America's Young Inventors program was established to enshrine great inventions produced by America's youth. The National Gallery complements the efforts of the National Inventors Hall of Fame by inducting six young people in grades K- 12 annually. In this way, the National Gallery is taking the great ideas of American youth and preserving them forever.
http://www.pafinc.com/nat_gal.htm

INVENT AMERICA!
This nonprofit K-8 education program, launched in 1987, helps children develop creative thinking and problem-solving skills through a fun, unique, learning tool—inventing!
http://www.inventamerica.com/

Activities and Worksheets

* Activities for invention contest booklet

Let's Go Inventing

Inventing is fun and exciting, and everyone can be an inventor! An inventor is someone who thinks of new ways to solve problems in the home, community, or even the world. These solutions are called inventions. An invention is a new discovery, or it can be a new product. It can also be a process—a new way of doing things. Inventions come about in many ways. Most of the time, inventions happen because someone had to solve a problem, but sometimes inventions are the result of accidents. No matter how an invention is created, it is important that you keep careful records to make sure that you get credit for first having the idea.

There are a few simple steps to follow in the invention process. Use the checklist below to make sure that you are staying on track and protecting your invention!

- ❑ Keep a log. All inventors keep a log to record their work and their ideas. Keeping a log will prove that you had an idea first, and it will help you plan your invention.
- ❑ Use your imagination. Think wild and crazy thoughts. Remember that no idea is too silly. Everyone laughed at the Wright brothers and said that man would never fly. Good thing the Wright brothers didn't get discouraged!
- ❑ Look for problems that need solving. Look around you to find things that bug you or for things that would make life easier or better.
- ❑ Plan and design your invention. Careful design is important in the invention process. This is the time to brainstorm for ideas and to evaluate them.
- ❑ Research your invention to make sure that it has not already been invented and that it will work.
- ❑ Draw your invention. Make a detailed drawing of your invention so others will understand how your invention works.
- ❑ Make a model of your invention.
- ❑ Test your invention. If you have a working model, test it to see if it works as planned. If not, do more research, redesign it, and test it again. This procedure is called an iterative process.
- ❑ Name your invention. Every invention needs a name!
- ❑ Patent your invention. If you think your invention is one that others would want, contact the U.S. Patent Office.
- ❑ Share your inventions with others!

Inventor's Log

Keeping a log is very important. It can prove that you had an idea first. It can also help you plan your invention and help you explain your invention to others when you are finished. Follow the suggestions below to help you keep a detailed and accurate log and become a true inventor!

- Every time you work on your invention, take notes and record when and where you were when you had the thought. Also record the results of the work. Date and initial your notes.
- Describe all your ideas, plans, designs, models, tests, and results in great detail. Details are very important because they help others understand your invention.
- When possible, make a drawing of your ideas and your design. Be sure to label all the parts clearly and correctly so that others will be able to understand how your invention works.
- If you need to buy items to build your model, describe the materials and keep a list of the costs.
- Photos can be included in your log because they are excellent proof of your invention.
- Be sure to have an adult sign your log. He/she will be a witness to prove that the idea and work are your own.

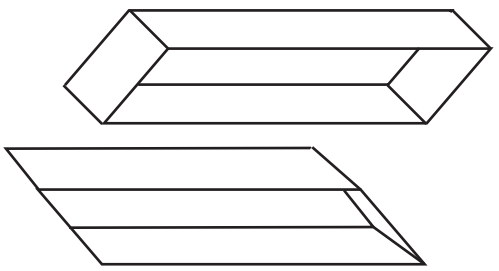
Sample Log

Name: Wilbur Wright **Date:** February 12, 1902
Witness: Orville Wright **Time:** 10:02 AM
Location: Wright Bicycle Shop, Dayton, OH

Details

Discussed with Orville the problem of control. After observing the bicycle tube box, an idea came to me – Wing warping.

Drawings or photos



Inventor's Log

Name: _____ **Date:** _____

Witness: _____ **Time:** _____

Location: _____

Details

Drawings or photos

Imagination Station

Anyone can be an inventor. All you need is a little imagination, ingenuity, and hard work. Your imagination is one of your most precious assets. Before you begin the invention process, loosen up your imagination by trying the activities below.

Take a Fantasy Journey

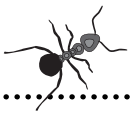
Have your partner close his/her eyes and read aloud the following fantasy journey.

> *Close your eyes and relax. Imagine yourself sitting on a beach. Watch the waves as they crash on the shore. Listen to the sound they make as they crash. Feel the Sun on your face. Do you hear the seagulls as they search for food? Imagine running your hands through the sand. How does it feel? Is it hot or cold, wet or dry, sticky or smooth? Imagine yourself building a sand castle. You wish you could see inside your castle. Suddenly, your body shrinks, and you are walking into the castle. What is inside? How many rooms are there? Imagine the people who used to live in castles long ago. What were they like? Now, just as suddenly as you shrank, you become big again. Your sand castle is wrecked. As you glance at the water, you notice that it has changed color. Imagine, in vivid detail, the color of the water. What creatures would live in an ocean that color? Imagine yourself swimming with them.*

Now, slowly open your eyes and illustrate your fantasy journey below.

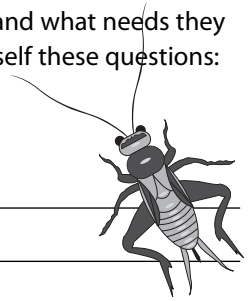
Imagine and write your own fantasy journey:

Bugging Out the Bugs



Everyday we have things that "bug" us. These can either be problems that we encounter or they can be needs that are not met. For example, if you want to take your dog for a walk, you will NEED a leash to keep him from running away. Who invented the leash? Someone who needed one! If you wear glasses, it might really bug you that they are always lost. You buy a strap that holds your glasses around your neck so that you can always find them. Who invented that strap? Someone who was bugged because they kept losing their glasses! Inventing is that simple. So lets get started!

Take a look around your home, school, and community to see what bugs you or what you need to make life easier or more pleasant. Survey your family, friends, or classmates to see what bugs them and what needs they have. Don't worry about solving the problem, that will come later. To get started, ask yourself these questions:



1. What bugs me the most?

   At school: _____

   _____

   At home: _____

   _____

   During playtime or sports: _____

   _____

2. What chore or job can I make easier? _____

   _____

3. What thing(s) do I want to work better? _____

   _____

4. Can I make something easier to use? _____

   _____

5. Are there new ways to use things I already have? _____

   _____

Survey of family, friends, or classmates:

1. What bugs you the most?
2. What would make your job easier?
3. What is your biggest need?
4. What job or chore do you not want to do?
5. (Write your own questions.)

The Wright Brothers

Purpose

To create a time line showing the invention process of Orville and Wilbur Wright as they worked toward successful flight

Materials

adding machine tape
7 m long
pencil
ruler
colored pencils (optional)
reference materials such as books, encyclopedias, and internet web sites

Procedure

1. To create a time line on the adding machine tape, draw a vertical line 5 cm from one end of the tape.
2. Mark this line "1867" for the year that Wilbur Wright was born.
3. Use the ruler to measure and draw a line every 7.5 cm.
4. Label each line with the next consecutive year. See diagram 1.
5. Stop at 1948, the year Orville Wright died.
6. Research the life of Orville and Wilbur Wright. Be sure to take notes.
7. Discuss and decide with your group which events are important and place them on the time line.
8. Using colored pencils, illustrate the events. (optional)
9. Share your time line with the class and display for all to see.

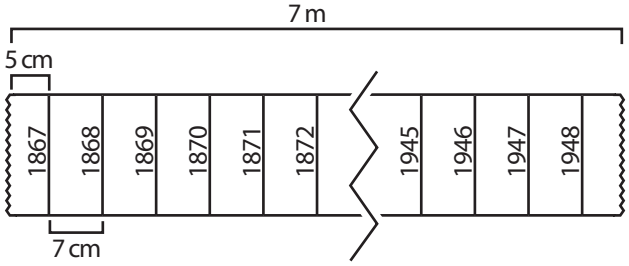


Diagram 1